

REMARKS

Claims 1-34 are pending. Of these, claims 1, 16, 27, 29-31 and 33 are written in independent format.

CLAIM OBJECTIONS

On page 2 of the Office Action, claim 29 is rejected under 35 U.S.C. §112, second paragraph, as being indefinite to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. By this reply, a clarification to claim 29 has been made. Thus, withdrawal of the rejection is requested.

§ 103 REJECTION: '180 PATENT + APA

Beginning on page 3 of the Office Action, claims 1, 6, 14-16, 20 and 24-34 stand rejected under 35 U.S.C. §103(a) as being unpatentable over the admitted previous art (APA)¹ of the specification in view of U.S. Patent No. 6,820,180 ("the '180 patent") to McBreaty et al. This rejection is traversed.

For simplicity, the following discussion assumes the context of, e.g., claim 1 unless noted otherwise.

The '180 patent discloses a cascaded mirroring arrangement based upon a logical volume manager (LVM) that makes use of a mirroring map; see column 2, lines 41-42 and column 1, lines 47-50. In FIG. 1, the '180 patent depicts a networked processing system in which a server 104, various clients thereof 108-112 and a storage unit 106 are connected via a network 102. The LVM corresponds to the logical layer 410; see column 5, lines 66-67. The mirroring map (or mirroring scheme; see col. 6, lines 29-30) is stored in LVM 410; see column 6, lines 36-37. The LVM 410 (and thus the mirroring map) are implemented on one of clients 108, 110 or 112; see column 4, lines 47-49.

In FIG. 5, the '180 patent depicts a mirroring map showing first through fourth physical storage systems (PSS-1, ..., PSS-4). The '180 patent, taken as a whole, reveals that PSS-1, ...,

¹ Applicant admits that the APA does not represent a point of novelty for the present application and will assume for the sake of argument that it is available under some section of 35 U.S.C. §102.

PSS-4 are connected in a typical daisy-chain manner. For this to be more easily understood, a discussion of the terminology in the '180 patent is helpful. The '180 patent refers to a "local backup mirror," a "remote backup mirror" and a "working mirror;" see column 6, lines 46-48.

A working mirror corresponds to the term "secondary storage entity" that is used in the "Background" Section of the present application. In a daisy-chained architecture, logically, the terms local backup mirror and remote backup mirror would correspond to a tertiary storage entity and a quaternary storage entity, respectively.

The '180 patent makes clear that PSS-2 510 corresponds to the term "primary storage entity" as used in the "Background" Section of the present application; see column 7, lines 29-34, which state:

One way to allow the application programs to continue reading and writing data [while a working mirror is being is being backed up (see column 7, lines 17-20)] is to split off the working mirrors. So, just before the time that PSS-3 520 is to be synchronized to PSS-1 500, PSS-1 may be disassociated with PSS-2 510. The application programs will continue to read or write from PSS-2 510 but not from PSS-1 500. After PSS-3 520 is synchronized to PSS-1 500, PSS-1 500 may be re-associated with PSS-2 510.

In a conventional mirroring pair, the primary storage entity receives writes from an external application. According to the above-quoted passage, application programs would continue to read from and/or write to PSS-2 510 when PSS-2 510 and PSS-1 500 are disassociated. Thus, PSS-1 500 (the "working mirror") is the secondary storage entity vis-à-vis primary storage entity PSS-2 510. Also, the tertiary storage entity is PSS-3 520 (the "local backup mirror"). Elsewhere (column 8, lines 26-27), it is stated that quaternary storage entity corresponds to PSS-4 530 (the "remote backup mirror").

The Examiner has asserted that PSS-2, ..., PSS-4 can be described as nodes N, N+1 and N+2, respectively. In view of the foregoing explanation, Applicant disagrees. However, Applicant is willing to assume for the sake of argument that PSS-2, PSS-1 and PSS-3 could be described as nodes N, N+1 and N+2, respectively.

The '180 patent also teaches that a modification table is stored in LVM 410; see column 6, line 54. Examples of modification tables are depicted in FIGS. 6-8. In FIG. 6, the table stores information indicating which data in working mirror PSS-1 500 has been modified since the last

time that it was backed up to local backup mirror PSS-3 520. In FIG. 7, the table stores information indicating which data in primary storage entity PSS-2 510 is new or has been modified since mirroring thereof by working mirror PSS-1 500 was interrupted ('disassociation') due to backing up working mirror PSS-1 500 to local backup mirror PSS-3 520. In FIG. 8, the table stores information indicating which data in local backup mirror PSS-3 520 is new or has been modified since the last time that it was synched with working mirror PSS-1 500.

Applicant agrees that the '180 patent does not suggest, must less disclose, the tracking of acknowledgements (ACKs) of forwarded writes as recited in claim 1. However, the Examiner believes that it would have been obvious to have modified the '180 patent according to the ACK-tracking of the APA, thus rendering claim 1 obvious. Applicant disagrees.

The APA describes a distributed type of ACK-tracking in which a storage node N is responsible only for updating its downstream mirror at a storage node N+1, the node N+1 is responsible only for updating its downstream mirror at a storage node N+2, the node N+2 is responsible only for updating its downstream mirror at a storage node N+3, etc. As such, at the node N, only ACKs from its downstream mirror at the node N+1 are tracked. At the node N+1, only ACKs from its downstream mirror at the node N+2 are tracked. At the node N+2, only ACKs from its downstream mirror at the node N+3 are tracked, etc.

Assuming for the sake of argument that the skilled artisan would have been motivated to adapt the '180 patent according to the APA, the following will also be assumed for the sake of argument. The result of the asserted modification would have been to add the ACK-tracking of the APA as another data structure (akin to the modification tables of FIGS. 6-8) stored in LVM 410, i.e., consolidate the distributed ACK-tracking of the APA in LVM 410. Such a modified LVM 410 would track ACKs by the node N+1 of writes forwarded to it by the node N, and would track ACKs by the node N+2 of writes forwarded by the node N+1. If the writes forwarded by the node N+1 correspond to writes that were forwarded to it (the node N+1) by the node N, then (by some application of the transitive property) perhaps the modified LVM 410 would track ACKs by the node N+2 of writes forwarded by the node N. As such, a single entity would operable to track acknowledgments by the node N+1 and by the node N+2 of writes that the node N has forwarded. If the ACK tracking were not consolidated on LVM 410, then no

single entity (i.e., a given node) would track anything more than ACKs by an immediately downstream node of writes that it (the given node) had forwarded.

The modified LVM 410 is susceptible, however, to a problem similar to that called out by Applicant; see the present specification at Paragraph 22. If the client (be it 408, 410 or 412) on which LVM 410 is hosted fails, then all of the ACK-tracking is lost. It is submitted that the skilled artisan would not have been willing to take such a risk. As such, LVM 410 would not have been modified as asserted by the Examiner. Consequently, no single entity (i.e., a given node such as PSS-2 510, PSS-1 500, etc.) would have been modified to track anything more than ACKs by an immediately downstream node of writes that it (the given node) had forwarded.

A distinction of claim 1 is the node N being operable to track acknowledgments by the node N+1 and by the node N+2 of writes that the node N has forwarded. As explained, LVM 410 of the '180 patent would not have been modified as asserted by the Examiner, so no single entity would have been operable to track acknowledgments by the node N+1 and by the node N+2 of writes that the node N has forwarded. However, assuming for the sake of argument that the modified LVM 410 would have resulted as has been asserted by the Examiner, modified LVM 410 would be hosted on one of clients 408, 410 or 412, i.e., not on node N as recited in claim 1.

Independent claims 16, 27, 29-31 and 34 recite a feature similar to the distinction of claim 1 noted above, respectively, and thus at least similarly distinguish over the combination of the '180 patent and the APA. Claims 6, 14-15, 20 and 24-28 depend at least indirectly from claims 1, 16 and 27, respectively, and thus at least similarly distinguish over the combination of the '180 patent and the APA.

In view of the foregoing discussion, withdrawal of the rejection is requested.

§ 103 REJECTION: '180 PATENT + APA + OTHERS

Beginning on page 5 of the Office Action, claims 2-5, 7-13, 17-19 and 21-23 stand rejected under 35 U.S.C. §103(a) as being unpatentable over the combination of the '180 patent and the APA in view of U.S. Patent No. 6,795,895 ("the 895 patent") to Merkey et al and U.S.

Pre-Grant Publication ("PGPub") No. 2005/0010731 ("the '731 PGPub") to Zalewski et al. This rejection is traversed.

Claims 2-5, 7-13, 17-19 and 21-23 depend at least indirectly from claims 1 and 16, respectively, and thus at least similarly distinguish over the combination of the '180 patent and the APA; see explanation provided above. Neither of the '895 patent nor the '731 PGPub has been cited as a teaching of the distinction of claim 1, nor would it be reasonable to assert either as teaching such. Hence, this rejection is improper and its withdrawal is requested.

CONCLUSION

The issues raised in the Office Action are considered to be resolved. Accordingly, Applicant again requests a Notice of Allowance.

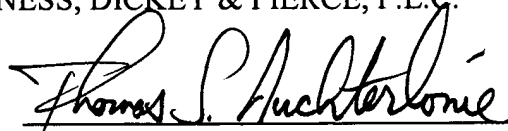
If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to contact the undersigned.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge any underpayment or non-payment of any fees required under 37 C.F.R. §§ 1.16 or 1.17, or credit any overpayment of such fees, to Deposit Account No. 08-2025, including, in particular, extension of time fees.

Respectfully submitted,

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